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VERMONT AGRICULTURAL
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BURLINGTON, VT.

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in Vermont in 1907-1909

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*In cooperation with Bu. An. Ind., U. S. Dept. Agr.

**BULLETIN 146: THE GRASS AND CLOVER SEED TRADE IN VER-
MONT IN 1907-1909**

BY GEORGE T. HARRINGTON

TABLE OF CONTENTS

Introduction	204
Summary	205
Previous seed studies	206
Good commercial seed defined	206
Seed of desired kind	207
Purity; freedom from weed seeds	208
Germinability and growth	208
The weed problem	209
Methods and limitations of seed control in Vermont.....	212
False economy of low grade seed purchase	213
Results of inspection	216
Tabular matter	218-226
Timothy	218
Red and alsike clover	222
Miscellaneous seed	226
1 Timothy	217
2 Red clover	228
3 Alsike clover	230
4 Miscellaneous seed	232
Whence come the weed seeds	234
Vermont's worst weeds in 1909	237
Vermont's worst weeds in 1872, 1891 and 1898, compared with those of 1909	238
The newer weed invasions	239

INTRODUCTION

The author of this bulletin—a graduate of the Agricultural Department of the University in the class of 1909, and now employed in the seed laboratory of the Bureau of Plant Industry of the United States Department of Agriculture—made a study of the grass and clover seed trade of Vermont as it has obtained during recent years, submitting the results thereof in the form of the senior thesis which is a regular pre-requisite of graduation. This bulletin is an abstract therefrom. Another graduate of the same class, Miss Alma L. Carpenter, studied the history of the grass and clover seed industry of the United States, presenting this as her senior graduating thesis. Her survey of this matter is now being worked over with a view of issuing it as a bulletin from the office of the State Commissioner of Agriculture. These two bulletins will supplement each other. Arrangements have been made whereby the latter bulletin issued by the Commissioner will be sent to the entire Vermont station mailing list.

JOSEPH L. HILLS, Director.

SUMMARY

Good seed should be true to name, reasonably pure and free from foreign matter, particularly weed seeds, and should germinate well and grow vigorously.

Seed control in the United States is of two sorts; the regular inspection of the trade under station auspices, which obtains in a few states and in Canada, and the sporadic testing of samples submitted by interested parties, buyers or purchasers. The latter method is the one now in vogue in Vermont.

A survey of 131 samples sent on for examination during the past three seasons indicates that:

1. The timothy seed was usually of good grade carrying normally but few weed seeds; that

2. The red clover seed samples varied widely in quality and showed a much lower average than did the timothy, many lots being very poor and some execrable as regards their weed seed contents; that

3. The alsike clover samples were highly variable in quality, none being as good as were some red clover samples and none as poor as were some of the red clovers.

The relationship of the trade in clover seed to the Vermont weed flora, both old and new, is pointed out, as well as the fact that legal enactment in other states, and particularly in Canada, tends to flood with low grade seeds other states in which no such enactments exist.

PREVIOUS SEED STUDIES

For twenty years the Vermont station has undertaken to analyze samples of grass and clover seeds sent by purchasers or dealers within the state, and to determine their purity with special reference to their weed seed content. It has furthermore made one quite systematic inspection of the trade in this commodity as well as two briefer studies.¹ Similar work, often of greater volume, has been done at many other stations as well as by the National Department, using either seeds forwarded by interested parties or those inspected in the open market. As a result there now obtains among the better informed farmers and seed dealers a clearer appreciation of the inferiority of poor seed, a better understanding of those qualities which collectively characterize good seed, and a more general and intelligent knowledge of the relationship between the character of the seed sown and the weed problem.

It is the primary purpose of this bulletin to present and briefly to discuss the results of seed tests made at this Station since 1907, and to review the concurrent trade conditions. Incidentally are pointed out the reasons for and the necessity of such means of seed control as may afford buyers reliable information as to purity and comparative values. Furthermore and finally, the limitations of the present situation as to seed sales as they obtain in Vermont are cited, and the results compared with those attained in other states and countries where efficient seed control measures are enforced.

GOOD COMMERCIAL SEED DEFINED

Good seed should be:

- (1). Of the kind and variety desired.
- (2). Reasonably pure and reasonably free from foreign material.
- (3). Capable of germinating well and growing vigorously.

¹Vt. Sta. Rpt. 11, pages 229-234 (1898); Rpt. 13, pages 287-299 (1900); Rpt. 17, pages 402-417 (1904).

(1). *Seed of the desired kind and variety.*—The importance of this matter is obvious. The buyer of clover seed cavils at the presence of material amounts of timothy which costs but half its price; and he who seeds down for market hay, using timothy as he should, decries an admixture of clover seed even though the latter is the more costly, because the presence of clover lowers the selling price of the hay. Kentucky blue grass is prized as the finest grass for lawns and pastures. A relatively high price being asked for genuine seed, it is often sophisticated, Canada blue grass (*Poa compressa*), an almost worthless species, being substituted in part or wholly therefor. Perhaps no other example could be cited which so well illustrates the necessity of careful expert examination. The distinctive characteristics of Kentucky and of Canada blue grass seed are sufficiently marked to admit of their certain identification by a trained analyst; yet the two are sufficiently alike and their distinctive characteristics are so apt to be overlooked, that the scrutiny of the ordinary purchaser or dealer does not detect substitution or sophistication. Roberts and Freeman¹ say that "while the ordinary observer can readily be taught to distinguish Canada blue grass from Kentucky blue grass in the field, the writers know of no really effective and satisfactory way of distinguishing the commercial seed of the two species that can be used by the ordinary purchaser. It remains in their judgment absolutely a question for the expert." Other common adulterants in commercial seed are:

Redtop chaff in Kentucky blue grass; Italian rye grass in orchard grass; rye grass in meadow fescue; bur clover and yellow trefoil in alfalfa; sweet clover and yellow trefoil in red clover. The certain detection of any of these admixtures necessitates expert observation. Unfortunately no method has been discovered save that of actual growth trials to distinguish from each other the seeds of many of the varieties of a single species, or in some cases to distinguish

¹Kans. Sta. Bul. 141, p. 108 (1907).

the seeds of separate species; as for example mammoth clover (*Trifolium medium*) from common red clover (*Trifolium pratense*).

(2). *Purity; freedom from foreign matter*.—Three items are important in this connection; the determination of the presence, the absence, or the relative abundance of:

- (a). "Inert matter" (chaff, sticks, pebbles, etc.)
- (b). "Foreign seeds" (i. e., other than of the kind bought).
- (c). "Pure seed" (actual kind bought).

The determination of these three items indicates the purity of the sample. The foreign seed content is usually subdivided into "weed seeds," or "noxious seeds," and "harmless seeds," the kinds and numbers of each per pound being specified.¹

(3). *Germinability and growth*.—Quite as important as the purity of the seed supply is its germinating power, its ability, when properly sown in a well tilled field, to produce an adequate growth. Of two lots of clover; one composed of 90 percent pure seed, nine-tenths of which is germinable and 10 percent of which is made up of harmless chaff, etc.; the other composed of 100 percent pure seed, half of which is incapable of germination; the former, impure sample is to be preferred for the reason that it furnishes 81 pounds of germinable seed as against 50 pounds; that it furnishes potentially a crop larger by 62 percent; that it is worth 16 cents a pound where the second grade is worth 10 cents. Of course this argument holds only if the impurity is of a harmless character.

Buyers are apt to judge the quality, probable germination and growth of their purchases by color and appearance. Doubtless fairly reliable indications are often thus furnished; yet only actual germination tests afford absolute certainty. This fact is well illustrated by occasional lots of fine appearing red clover seed which may contain as much as 40 percent of the so-called "hard seed." The outer seed covering of this "hard seed" is so in-

¹See pages 218-219 and comments thereon.

durated as to retard the imbibation of water; hence it lies in the soil for months or years without change and consequently has relatively low agricultural values.¹

In selecting seed, not only these three points above mentioned should be kept in mind, that is to say the proportion of actual seed true to name, its germinating powers and the purity and freedom from weed seeds, but also a fourth, viz., the "actual value" bought for a given price. The weight of true clover seed capable of germination bought for a dollar rather than the pounds of more or less pure seed purchased for that price should be the criterion. According to this measure a relatively costly seed may prove the cheapest. Yet one should not fail to remember that the financial measure is not the sole standard by which one should determine purchase. One should not buy seed, even though the price is reasonable and its germinating powers good, if it contains any material number of weed seeds.

THE WEED PROBLEM

Seed purity and germinability are important; yet the control of the weed seed situation is more so. Foreign, harmless seeds cause some slight loss, but weed seed admixtures are pestiferous. So many kinds and in such numbers occur in some poorly cleaned commercial seeds as to constitute at once a menace to good farming and a justification of the institution of a seed control. The use of seed of low germinating powers, of weak growth, or laden with inert matter, damages the one individual for one year and one crop. Not so with the use of the weed laden seed, for, generally speaking, the weed seeds thus sown are those which have matured at the same time as or slightly before the crop seed, and, being planted therewith, they are apt to continue so to do. Every weed in the meadow occupies the room which should be utilized by a more nutritious and palatable plant. It

¹Nobbe has shown that certain samples of red clover seed after 26 years' immersion in water still maintained their relatively hard character.

appropriates to itself the plant food and moisture which otherwise would be available to crop growth. If it matures seed, its power for evil during succeeding years is multiplied indefinitely, both to the home farm and to the neighborhood, if the seed are of the sort which are carried by winds, birds or otherwise.

Weeds propagated by underground stems or rhizomes, such for example, as quack grass or witch grass¹ and orange hawk-weed or paintbrush² are peculiarly apt to increase their ability to do harm. The persistence of witch grass and its rapid spread are the despair of the Vermont farmer; and the rapid spread of the hawk weed or paintbrush by means of a wind blown seed has carried it within a score of years to almost every part of the state.³

Weeds are not the private problem of the individual; they are a public nuisance, the control of which concerns all mankind and not the intelligent husbandman alone. Though other avenues of introduction exist—railroads, escaped ornamentals, etc.—the two means whereby most of the new weeds gain entrance and old weeds become more widely distributed, are commercial seeds of poor quality, and certain commercial feeding stuffs which carry unground or untreated screenings from flour mills and from the seed screening machines. The commercial seed inlet admits the greater number. All farmers must needs use seed, whereas they need not use feeding stuffs which are under suspicion. Furthermore, the feeding stuffs inspection has served, to some extent at least, to point out the sinners among feeds, whereas no such system is in vogue as to the seed trade. The relationship of the feed supply to this situation will not be further discussed in this bulletin, as it has been reviewed in detail in previous issues (bulletins 131, 133, 138, 144).

¹This station will shortly publish a bulletin, No. 149, dealing with a satisfactory method of combatting witch grass.

²See Vt. Sta. Bul. 56 (1896).

³See in this connection the comparatively small area in Vermont seriously infested in 1896, as indicated in bulletin 56.

SEED CONTROL

It is evident from what has been said, and in view of the fact that few men are able to judge intelligently of the comparative merits of seeds, that vigilance is needed to minimize the weed seed distribution due to the use of commercial seeds. Herein lies the value of systematic seed control. In most European countries this need has given rise to a well regulated system, whereby seed dealers voluntarily place themselves under the jurisdiction of seed testing stations, guaranteeing their products, using station tests as the basis therefor, and submitting questions arising under this system to the decision of the station as arbiter. Several of the stations in this country make free analyses of seed samples sent them for that purpose by purchasers or dealers. In a few of the states (Maine, New Hampshire, Connecticut, Kentucky, Iowa and perhaps others) more or less efficient laws are in force providing for systematic seed inspection, the aim of which is to control the local seed trade. The seed control act of Canada, passed in 1906, fixed standards for timothy, red and alsike clovers or their mixtures, sold as first quality. These must not only be of a prescribed purity and germination, but also be free from specified weed seeds. The same law prescribes that certain weed seeds—a less extensive list—must either be entirely absent from the seeds of cereals, grasses, clovers and forage plants, or that their presence must be stated on the packages. It further expressly declares, as do also the statutes of certain states in this country, in effect that “the provisions contained in this act shall not apply to seeds marked ‘not absolutely clean’ and held or sold for export only.”¹

Such a proviso insures the exportation of such inferior products beyond the borders of Canada, or the states or European countries thus protecting themselves. The purveyors of such seed will naturally seek an outside market for such of their

¹Dom. Can. Dept. Agr. Bul. 1 (revised edition) (1908).

wares as are too foul for home sales. Much Canadian rejected seed has been sold of late in Vermont, especially in 1907 immediately after the passage of the Canadian seed control act.

METHODS AND LIMITATIONS OF SEED CONTROL IN VERMONT

The seed control of Europe, involving voluntary guaranties by dealers, does not obtain in America. Two situations occur here; one wherein the station merely tests such samples as are forwarded, without making an attempt at state wide inspection; and one wherein the station conducts such inspection by the collection and analysis of samples drawn in open market, on the strength of which inspection it estops illegal sales. There is no seed law on the statute books of Vermont; hence no systematic work is done. Under such circumstances the extent of the work depends upon the initiative of the individual farmer; the responsibility is lain upon the purchaser or dealer. He who sells or buys may, if he will, know as to the quality of the particular lot he has in hand. The assurance of good seed has thus been afforded in multitudinous cases, and the discovery of that of inferior quality has also been made in many cases. Many buyers accomplish this end by seeking only the best grades from reliable dealers; or else by personal examination and comparison of the various grades as found upon the market. But many less thoughtful buyers on the contrary, because either of ignorance or of carelessness, buy and sow low grade seed, large amounts of which are sold within the state, and their fields become both neighborhood eyesores and neighborhood menaces. Against such a situation he who sows good seed and strives to eradicate weeds from his farm has neither protection nor redress. Doubtless the buyers of the lower grades rarely appreciate the facts. No one deliberately buys weed seeds. The saving of money, which is the bait put forward by the seller, is what attracts. The deliberate catering to the demand for a low priced seed, with quality and purity a secondary consideration, or the equally harmful though less reprehensible policy of the purveying of foul seed through

ignorance or carelessness, alike tend to spread weeds. The real fault lies with the buyer. If he get about it early enough he can determine where he may obtain really good seed; but he rarely does this. The better class of seed dealers prefer to carry the higher grades, but find it difficult to persuade farmers against the false economy of buying the lower grades. And so long as a demand exists for such it will be supplied. Per contra, when farmers will pay for better goods, dealers will gladly carry them.

The station's analytical work is of aid to the trade and to discriminating buyers only in so far as they make use of it. Its limitations and defects lie in its necessarily unsystematic character. Without legal sanction and without funds, the Station is powerless to do more than call attention to its willingness to handle samples sent by individuals, so far as lies in its power.¹ Especial attention is called however to the fourth proviso in the footnote. Samples received at the last moment before seed time, accompanied by a request for a report "by return mail," cannot be usually handled to the satisfaction of the sender. They should be sent far in advance of the time of need, and ample time allowed for the necessarily slow process of examination.

FALSE ECONOMY OF LOW GRADE SEED PURCHASES

The following instances serve to show the false economy of buying low priced and inferior seed. Doubtless red clover is the foulest seed on the Vermont market. It varies most in price as compared with grade, and represents greater ranges in quality than occur with any other widely sold commercial seed.

¹"Free analytical work is done without charge to the residents of the state if received not too frequently from one individual, provided: (a) the work appears to be of public benefit and the results are at the disposal of the Station to publish if it deems advisable; (b) the samples are taken in accordance with directions formulated and furnished by the Station; (c) the carriage charges are prepaid; (d) it is physically possible to do the work within a reasonable time and without serious interruption to regular and stated duties.

Agricultural seeds, as to purity: If germination tests are desired the samples, if in too large numbers, may be declined or else submitted to the Seed Laboratory of the National Department of Agriculture." Vt. Sta. Circ. 3 (1909).

Moreover its selling price is unfortunately no necessary index of its 'quality. Indeed, it happens not infrequently that a medium priced seed may be a cleaner and wiser purchase than is that of a relatively high priced goods. It is the quality and not the price that should be the criterion.

	Sample number		
	39	42	34
True clover seed.....	58.2%	63.2%	87.4%
Weed and harmless seeds	28.9%	19.9%	4.6%
Inert matter (mostly immature seed)	12.9%	16.9%	8. %
Weed seeds, per pound	49,600	36,400	15,700
Harmless seeds, per pound	160,200	98,900	15,300
Recognized varieties of weed seeds.....	18	25	15
Recognized varieties of harmless seeds....	5	4	4

For full data see pages 222-225. "There are others" (see numbers 36, 40, 43, and others, pages 222-223).

In comparison with these products of the seed dealer's art may be placed numbers 16, 17, and 20.

	Sample number		
	16	17	20
True clover seed	99.1%	99.0%	99.2%
Weed and harmless seeds.....	0.1%	0.4%	0.2%
Inert matter (largely broken seed).....	0.8%	0.6%	0.6%
Weed seeds, per pound	100	1,700	300
Harmless seeds, per pound	100	4,700	600
Recognized varieties of weed seeds.....	1	7	3
Recognized varieties of harmless seeds....	1	3	1

There are plenty of others. Good seed is obtainable, if wanted.

Viewing sample 39 in another way: If 8 pounds were sown per acre there would be thus distributed:

172,000	seeds of	barn grass (green foxtail)
59,200	" "	sheep sorrel
51,200	" "	pigweed (lambs' quarters)
28,800	" "	docks
38,400	" "	two varieties of plantain
19,200	" "	sticky cockle (catchfly)
28,000	" "	other weeds

396,800 weed seeds per acre

Twenty-five thousand weeds per square rod, plants of a sort notoriously well able to thrive, owing to their early and vigorous growth. Furthermore, a nearly pure stand of grass or clover can more readily combat a few weeds than can less perfect stands wage successful war with considerable numbers,

A yet more inferior quality of seed than number 39 was recently analyzed at the United States Department of Agriculture. But half its content was true to name. It carried to the pound 199,000 harmless seeds of six varieties and 77,000 weed seeds of thirty known varieties. The germination of the true seed was 48 percent. It carried at best not more than approximately 96,000 living clover seed per pound, along with at least 37,000 weed seeds capable of thriving and nearly 100,000 of other and harmless though undesirable seed.

Goods like number 39 and the sample just cited are not commonly sold in such foul condition. They are usually re-cleaned by the wholesale seedsman, or used in so-called "grading down" of better material to meet market demands for a cheap seed. If re-cleaned, their power for evil is minimized. If used as a diluent, their power for evil is magnified, for a noxious seed is more largely distributed over a larger area and given ample opportunity for establishing itself. Much of the low grade seed is thus graded down, and is on that account more objectionable than is a low grade product grown in a given locality and not mixed with seed elsewhere grown. Seed such as is exemplified by numbers 39, 42, 34, or the department sample, is much more expensive as an initial purchase than is seed of the quality of numbers 16, 17, and 20. That is to say, the actual clover seed contained in the poorer quality costs more than does that contained in the better quality. Indeed, one may, if he will, close his eyes to the weed seed contents, and base the argument solely on the clover seed contents of the two grades, and easily prove the better to be the cheaper. Their actual values may be determined by multiplying purity percentages by germination percentages. Assuming an 80 percent germination for No. 17 (unquestionably a low estimate) and for No. 39 (doubtless a high estimate, because of the shrivelled character of the seed), and using the actual selling prices, 20 cents for No. 17 and 15 cents for No. 39, the following data are obtained:

	Sample number		U. S. D. A.
	17	39	sample
Pure seed in 100 pounds.....	99 lbs.	58 lbs.	50 lbs.
Germination	80%	80%	48%
Germinable clover seed in 100 pounds...	79 lbs.	47 lbs.	24 lbs.
Price per pound	20 cts.	15 cts.	.....
Price per pound of pure seed.....	20.2 cts.	25.9 cts.	.....
Price per pound germinable red clover seed	25 $\frac{2}{3}$ cts.	32.9 cts.	.....
Relative values per pound	20 cts.	11.9 cts.	6.1 cts.

In view of the fact that the actual red clover seed in number 39 and the departmental sample was shrivelled and doubtless less capable of vigorous growth than that in number 17, the above statement unquestionably overvalues the poorer products.

RESULTS OF INSPECTION

During the past three years 131 samples of seed have been sent in for report as to purity. Germination tests could not be made for lack of available appliances. These receipts consisted of the following sorts: Timothy 53 samples, red clover 43, alsike clover 18, red top, 5, alfalfa 3, oats, barley and Japanese millet, each 2, Kentucky blue grass, orchard grass, Hungarian, each 1. The detailed statement as to their purity, the percentages of foreign seed and of inert matter, and the numbers of noxious and of harmless seed per pound, with a statement of the numbers of each species and of the general grade of the seed appears on pages 218 to 226 inclusive. These somewhat formidable tables are discussed on page 217 and on pages 227 to 234 inclusive. It is realized that the small number of samples tested, 131 in all, is far from being representative of the Vermont trade in this important commodity. Yet, since the samples were received from all sections of this relatively small state, it is thought that the results obtained afford some index of the character of the trade, and that they show the common purveyal of both bad and good grades.

DISCUSSION OF RESULTS EXHIBITED IN TABLES ON PAGES 218-226

1. *Timothy (53 samples).*—As a whole the timothy seed was found to be of good grade. Two lots (No. 6 of 1907 and No. 191 of 1909) carried respectively 13,000 and 21,000 weed seeds per pound. But one other lot (No. 119 of 1908) carried in excess of 3,000. In 1907 two lots carried more than one percent impurities; in 1908 four lots; in 1909 three lots; or a total of about one in six. Only two lots carried more than 1.4 percent impurities; but, as above remarked, these were bad ones. The quality of the 1909 goods, so far as may be judged by the limited number of samples inspected, was somewhat inferior to that of the two preceding years. Considerable ergotized seed was observed, however, in 1908, although the average seed under survey that year showed higher purity than did that sold in either of the other years. An ergotized seed is undesirable but it is not a serious menace. The fruiting bodies of ergot grow in nearly all fields and their relative amount and vigor are largely dependant upon meteorological conditions. Hence the use of an ergotized seed does not create but simply augments the danger. One lot (No. 118) contained a few seed of field dodder, a most objectionable weed rarely found in timothy but all too common in clover and alfalfa.

Timothy seed is commonly marketed in good condition. The crop is usually grown in pure stand, seeds abundantly, and is readily harvested, cured, and cleansed. Hence it is easy to produce a high grade seed at a low price; yet farmers and dealers alike seem to be watching the quality of timothy seed more carefully than that of any other crop. This is doubtless due in part to its very general use. It is not suggested that less vigilance be employed in this respect, but that more care be exercised in the purchase of clover seed.

Timothy seed carries few weed seeds. This is a matter of common knowledge and is abundantly borne out in the results reported herewith. Only 26 species of weed seeds were iden-

TESTS OF TIMOTHY SEED

NOXIOUS SEED
(Hundreds)

Sample number	Pure seed, percent	Foreign seed, percent	Inert matter, percent	Noxious seed, per pound, hundreds	Harmless seed, per pound hundreds	Grade	Red stemmed plantain, hundreds	Five finger, hundred	Common plantain hundreds
4	99.3	0.2	0.5	4	6	G	4	..	..
5	99.6	0.2	0.2	4	12	G	..	2	..
6	94.8	3.1	2.1	130	1034	L	16	68	13
7	99.8	0.1	0.1	2	4	E	..	..	2
8	99.9	...	...	2	..	E	..	..	2
9	99.1	0.6	0.3	20	52	G	16	4	..
10	99.8	0.1	0.1	..	4	E	..	..	..
15	99.3	0.2	0.5	4	14	G	2	..	..
18	99.5	0.3	0.2	8	17	G	2	2	..
21	99.6	...	0.4	..	..	E	..	..	..
30	99.8	0.1	0.1	..	6	E	..	..	..
33	99.3	0.4	0.3	16	40	G	7	7	..
35	99.3	0.4	0.3	13	30	G	4	..	..
37	99.8	0.1	0.1	2	11	E	..	2	..
44	99.1	0.6	0.3	2	47	G	2	..	..
47	99.8	0.1	0.1	2	4	G	..	..	..
48	99.6	0.2	0.2	6	12	G	..	..	..
52	98.6	0.6	0.8	16	43	G	..	9	..
60	99.3	0.2	0.5	2	45	G	..	..	..
62	99.8	...	0.2	..	..	G	..	..	..
77	99.4	0.2	0.4	9	4	G	7	..	..
78	98.9	0.7	0.4	29	25	F	18	..	..
89	99.8	...	0.2	2	2	E	..	..	..
93	98.6	0.6	0.8	4	56	F	..	..	..
96	99.7	0.1	0.2	2	7	E	..	..	..
98	98.6	1.1	0.3	19	60	F	9	2	..
100	99.5	0.3	0.2	26	2	G	7	..	..

NOTE. The numbers of seeds as shown in the table are expressed as hundreds, omitting the tens and units; thus, for example, the number 16 under the caption red stemmed plantain means that there were present in a pound of the seed under examination sixteen hundred (1600) seed of this particular weed.

TESTS OF TIMOTHY SEED

NOXIOUS SEED (Hundreds)

HARMLESS SEED (Hundreds)

Yellow daisy, hundreds	Lamb's quarters, hundreds	Peppergrass, hundreds	Evening primrose, hundreds	Sheep sorrel, hundreds	Sedges, hundreds	Miscellaneous seeds, hundreds (See footnote)	Red clover, hundreds	Alsike clover, hundreds	White clover, hundreds	Redtop, hundreds
..	..	..	..	..	..	*	..	2	2	2
2	..	..	..	..	..	..	..	4	2	4
22	..	..	..	7	..	2a,2b	2	39	13	980
..	..	..	..	..	..	..	2	2	..	..
..
..	..	..	..	..	..	..	2	27	16	7
..	..	..	..	..	..	..	2	..	2	..
2	..	..	..	..	..	..	..	14	..	..
2	2	..	..	..	..	..	..	9	4	4
..
..	..	..	..	..	..	..	2	..	2	2
2	..	..	..	..	..	..	2	7	4	27
..	..	..	..	2	7	..	9	14	7	..
..	..	..	..	..	..	..	..	2	2	7
..	..	..	..	..	..	..	..	45	2	..
..	..	..	2	..	..	..	..	..	..	4
..	..	..	2	..	..	2c,2d	4	4	4	..
7	..	..	..	..	..	..	7	11	9	16
..	..	2	..	..	..	..	..	2	..	43
..
..	2	..	..	..	..	..	..	4	..	..
..	7	2	..	..	2	..	18	7	..	..
..	..	..	..	..	..	2e,*	2	..	..	..
..	2	2	..	..	..	*	..	20	13	23†
..	2	..	..	..	..	..	..	..	7	..
4	..	4	..	..	..	..	13	43	4	..
..	4	9	..	..	..	4f,2g	..	2	..	..

Grade marks—E excellent, G good, F fair, P poor.

*Inert matter contains ergotized seed: †Canada blue grass; a, Docks; b, Chickweed; c, Spring amaranth; d, Healall; e, Crabgrass; f, Dog fennel; g, Canada thistle; h, Mullein; i, Vervain; k, Field dodder; l, Ribgrass; m, Hedge mustard; n, Lady's thumb; o, Green foxtail.

TESTS OF TIMOTHY SEED

NOXIOUS SEED (Hundreds)

Sample number	Pure seed, percent	Foreign seed, percent	Inert matter, percent	Noxious seed, per pound, hundreds	Harmless seed, per pounds, hundreds	Grade	Red stemmed plantain, hundreds	Five finger, hundred	Common plantain hundreds	Yellow daisy, hundreds
102	99.6	0.1	0.3	11	7	G	2	2	..	..
106	99.3	0.5	0.2	6	44	G	E	..	..	..
110	99.7	0.1	0.2	..	13	E	..	..	..	..
111	99.8	..	0.2	..	..	E	..	..	..	..
117	99.1	0.5	0.4	19	27	G	9	..	..	..
118	99.5	0.1	0.4	6	9	E	..	..	..	..
119	98.8	0.5	0.7	31	42	G	..	12	4	..
120	99.8	0.1	0.1	2	..	E	..	..	..	..
122	99.9	..	0.1	..	2	E	..	..	..	..
124	99.5	0.3	0.2	8	22	G	4	2	..	..
136	99.7	0.1	0.2	4	..	E	..	..	..	..
137	99.3	0.2	0.5	15	14	G	..	..	..	..
138	99.3	0.4	0.3	16	22	G	..	..	7	..
189	98.9	0.6	0.5	9	29	G	7	..	..	..
190	99.5	0.1	0.4	..	2	E	..	..	..	..
191	92.8	4.9	2.3	210	241	L	101	45	18	4
192	99.1	0.5	0.4	..	22	G	..	..	..	..
193	98.7	0.7	0.6	9	22	G	..	..	7	..
196	99.9	..	..	4	..	E	2	..	..	..
197	99.9	..	..	2	2	E	..	..	..	..
198	99.6	0.2	0.2	6	8	E	..	..	2	..
207	99.5	0.2	0.3	4	11	E	2	..	..	..
209	99.6	0.1	0.3	..	4	E	..	..	..	..
210	99.5	0.2	0.3	8	9	G	..	..	2	..
211	99.0	0.3	0.7	4	9	G	..	..	..	..
216	99.2	0.2	0.6	6	7	G	4	..	..	..

NOTE. The numbers of seeds as shown in the table are expressed as hundreds, omitting the tens and units; thus, for example, the number 16 under the caption red stemmed plantain means that there were present in a pound of the seed under examination sixteen hundred (1600) seed of this particular weed.

TESTS OF TIMOTHY SEED

NOXIOUS SEED (Hundreds)

HARMLESS SEED (Hundreds)

Lamb's quarters hundreds	Peppergrass, hundreds	Evening primrose, hundreds	Sheep sorrel, hundreds	Sedges, hundreds	Miscellaneous seeds, hundreds (See footnote)	Red clover, hundreds	Alsike clover, hundreds	White clover, hundreds	Redtop, hundreds
..	7h	..	..	..	7
..	2b, 4i*	4	33	..	2
..	*	7	2	4	..
..	*
2	2	4	..	..	..	9	18	..	..
..	..	4	..	..	2k	..	9	..	..
7	4	2	2l	2	9	4	27
..	2	..	..	..	..	..	..
..	2
..	2l	2	7	13	..
..	..	2	..	..	2m*	..	..	..	..
9	4f, 2i	..	7	7	..
..	2	7	..	..	..	2	18	2	..
..	2	..	..	..	29	..	..
..	2	..
..	4	..	14	..	7i, 4e, 2d, 9n, 2o	43	137	67	..
..	22	..	..
..	2n	22	..	..	..
..	..	2	..	..	..	..	..	..	..
..	..	2	..	..	..	..	2	..	..
..	2	2	..	4	4	..	..
..	2	..	7	..	4	..
..	4	..
..	4	..	..	..	2a	2	..	7	..
2	2o	2	7	..	..
..	2	..	..	..	..	..	7	..	..

Grade marks—E excellent, G good, F fair, P poor.

*Inert matter contains ergotized seed; †Canada blue grass; a, Docks; b, Chickweed; c, Spring amaranth; d, Healall; e, Crabgrass; f, Dog fennel; g, Canada thistle; h, Mullein; i, Vervain; k, Field dodder; l, Ribgrass; m, Hedge mustard; n, Lady's thumb; o, Green foxtail.

TESTS OF RED CLOVER SEED

NOXIOUS SEED (Hundreds)

Sample number	Pure seed, percent	Foreign seed, percent	Inert matter, percent	Noxious seed, per pound, hundreds	Harmless seed, per pound, hundreds	Grade	Green foxtail	Ribgrass	Red stem plantain	Sheep sorrel	Nightflowering catchfly	Lambsquarters	Old witch grass	Slender crabgrass	Curled dock	Yellow foxtail
2	99.0	0.4	0.6	4	19	G	..	..	..	..	..	..	..	..	4	..
11	91.5	5.1	3.4	104	353	P	..	9	3	5	..	4	..	..	14	..
13	96.3	2.4	1.3	14	99	F	..	2	5	..	..	..	..	..	1	..
16	99.1	0.1	0.8	1	1	E	..	..	..	..	..	..	..	..	1	..
17	99.0	0.4	0.6	17	47	G	3	..	2	4	..	..	..	..	3	..
20	99.2	0.2	0.6	3	6	E	1	..	1	1	..	..	..	..	..	..
22	99.2	0.2	0.6	5	1	E	3	..	..	..	..	..	..	..	..	..
32	99.2	0.3	0.5	10	1	E	5	..	3	..	..	..	1	..	..	..
34	87.4	4.6	8.0	157	153	P	35	36	23	9	5	8	3	20	5	..
36	88.4	5.5	6.1	152	184	P	38	27	20	10	3	10	8	17	5	..
39	58.2	28.9	12.9	496	1602	P	215	14	34	74	24	64	..	1	..	5
40	75.0	15.0	10.0	347	527	P	137	16	39	10	19	38	10	4	15	..
42	63.2	19.9	16.9	364	989	P	89	23	38	9	66	26	7	7	34	5
43	75.3	18.0	6.7	191	1225	P	24	14	16	33	20	11	2	9	..	2
46	91.2	5.5	3.3	73	382	P	2	2	9	32	3	1	..	7	..	..
50	86.1	5.0	8.9	87	223	P	48	15	..	2	4	8	..	..	..	..
51	86.8	6.6	6.6	63	171	P	6	1	22	2	..	3	5	17	2	..
76	96.5	1.6	1.9	42	53	F	1	36	..	..	..	..	..	..	..	..
79	97.8	0.7	1.5	8	44	G	1	1	..	1	..	1	..	1	..	..
81	98.8	0.4	0.8	7	2	E	1	..	..	..	..	..	..	..	4	..
88	97.4	1.3	1.3	51	17	F	3	36	1	..	..	..	4	2	..	..
90	99.0	0.5	0.5	11	1	E	..	..	..	..	..	..	1	..	..	..
91	97.0	0.5	2.5	14	3	E	8	..	..	..	..	..	..	..	..	2
92	97.5	0.4	2.1	9	3	E	1	1	..	..	1	4	..	..	..	1
95	90.9	6.5	2.6	198	187	P	50	24	22	9	14	4	20	8	3	3
97	96.1	1.3	2.6	48	20	F	9	17	2	..	..	1	7	3	..	3
107	84.0	12.8	3.2	349	558	P	125	32	14	5	13	39	13	8	7	3

Grade marks—E excellent, G good, F fair, P poor.

NOTE. The numbers of seeds as shown in the table are expressed as hundreds, omitting the tens and units; thus, for example, the number 16 under the caption red stemmed plantain means that there were present in a pound of the seed under examination sixteen hundred (1600) seed of this particular weed.

The inert matter was quite commonly made up of dirt, chaff, sticks, straw, etc. In the cases cited below more or less seed was found in the conditions indicated.

Wormy and broken.....11, 12, 126, 127, 128
 Large, broken.....16, 20, 79, 80, 81, 88, 91, 92, 95, 97, 103, 107, 108,
 109, 115, 130, 141, 143, 144, 199, 202, 208, 212, 213
 Flat, immature34, 39
 Broken, immature51, 94, 159, 195
 Shrivelled, shrunken36, 45, 46, 49, 135, 188, 214, 218
 Shrunken and sprouted99
 Dried up43
 Ergotized116, 145, 206
 "Poor"40, 42, 50

TESTS OF RED CLOVER SEED

NOXIOUS SEED (Hundreds)

HARMLESS SEED
(Hundreds)

Lady's thumb	Dog fennel	Plantains	Crabgrass	Kale	Yellow trefoil	Spiny sida	Docks	Panicums	Peppergrass	Ragweed	Five finger	Spurge	Red root plantain	Healall	Miscellaneous seeds (see footnote)	Alsike clover	White clover	Timothy	Miscellaneous
..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	58A,1B	13	4	2	..
..	3	3	..	..	..	..	..	4	..	..	..	..	..	..	1C	13	99	241	..
..	..	1	..	..	..	..	..	4	..	..	..	..	..	..	..	38	24	36	1*
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
1	..	..	..	1	..	..	..	3	..	..	..	..	..	..	..	3	24	20	..
..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	6	..	..	..
..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..
4	5	1	..	..	..	..	..	..	1	1	..	..	..	..	1D	43	30	79	1†
..	9	1	..	..	..	..	2	..	..	..	..	..	..	..	2E	35	50	97	2‡
5	1	..	..	10	..	36	..	3	..	1	..	..	..	..	(I)	772	118	700	8*4†
20	1	..	..	5	..	19	..	..	..	..	..	..	..	..	(II)	136	37	356	..
12	4	1	..	5	25	..	..	1	..	..	1	..	..	..	(III)	361	85	540	3*
8	18	..	..	3	1	17	..	..	1	..	5	..	..	..	5I,1J,1K	425	194	606	..
..	5	..	..	..	..	..	..	1	..	..	..	..	..	..	3R,2F,1S	127	128	126	1†
2	2	..	..	..	5	..	..	..	..	..	..	..	..	..	1J	78	34	110	1†
1	..	..	..	..	..	..	..	..	..	..	..	2	1	1T	28	34	106	2†1‡	
..	..	..	..	..	..	1	..	..	..	..	..	..	1	3U,1V	..	..	53	..	
..	..	..	..	..	..	..	..	..	..	2	..	..	..	1	1J	17	3	24	..
1	..	..	..	..	..	..	..	..	..	..	..	1	1	..	2W	1	..	1	..
..	..	..	..	..	10	..	..	..	..	..	..	..	..	..	..	4	..	13	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A,2X	..	..	..	3‡
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1Y	..	..	..	3‡5¶
..	..	6	7	..	5	..	..	1	..	..	3	..	..	..	(IV)	53	37	90	2‡
..	..	..	1	..	..	..	..	..	..	..	1	..	..	..	2f,1W	..	..	..	..
14	8	11	5	6	3	1	7	3	3	1	..	..	..	..	(V)	..	..	..	..

*German millet. †Red top. ‡Alfalfa. ¶Meadow fescue. §Canada blue grass.

A, Sweet clover; B, Goat's rue; C, Bracted plantain; D, Bitter sweet; E, Low amaranth; F, Canada thistle; G, Chickweed; H, Black mustard; I, Arrowhead tear-thumb; J, Catnip; K, Vervain; L, Smartweed; M, Wild buckwheat; N, Dotted smartweed; O, Spring amaranth; P, Quack grass; Q, Centaurea sp.; R, Three-seeded mercury; S, Nettle; T, Suckling clover; U, Chicory; V, Wild carrot; W, German knot-grass; X, Scentless camomile; Y, False flax; Z, Prairie ribroot.

a, Slender paspalum; b, Pennyroyal; c, Barn-yard grass; d, Mint; e, Nightshade; f, Bitter dock; g, Bladder ketmia; h, Bur clover; i, Polygonum sp.; j, Shepard's purse; k, Ox-eye daisy; l, Sprouting crab grass; m, Ground cherry; n, Field bind weed; o, Bull thistle; p, Pennycress; q, Coral berry; r, sedge; s, Hedge mustard; t, Balm; u, Bromegrass; v, Purslane; w, Evening primrose; x, Yellow rocket; y, White top.

39 (I) 4F, 3L, 3E, 1G, 1A; 40 (II) 3E, 2M, 1N, 1O, 1P; 42 (III) 3E, 2L, 1Q, 1K, 1J, 1O, 1B; 93 (IV) 5Z, 5a, 2b, 2C, 2c, 2d, 1W, 1e; 107 (V) 5Z, 4F, 3c, 1G, 1e, 1a, 1g, 1W, 1N, 1r; 109 (VI) 4h, 2W, 2a, 1Z; 126 (VII) 7I, 5W, 4C, 3m, 1R, 1n; 127 (VIII) 9I, 7W, 5C, 3o, 3c, 1p, 1n, 1N, 1q, 1h.

TESTS OF RED CLOVER SEED

NOXIOUS SEED (Hundreds)

Sample number	Pure se.d, percent	Foreign seed, percent	Inert matter, percent	Noxious seed, per pound, hundreds	Harmless seed, per pound, hundreds	Grade	Green foxtail	Ribgrass	Red stem plantain	Sheep sorrel	Nightflowering catchfly	Lambsquarters	Old witch grass	Slender crabgrass	Curled dock	Yellow foxtail
108	97.6	0.3	2.1	12	..	E	3	3	..	..	..	..	..	..	..	..
109	97.1	1.8	1.1	94	5	F	51	6	..	..	..	..	1	11	1	5
116	94.0	4.1	1.9	85	241	P	16	7	23	11	2	5	1	5	5	1
126	85.2	11.8	3.0	312	559	P	103	32	20	8	9	27	5	14	..	7
127	83.5	11.9	4.6	249	516	P	138	29	9	9	14	34	6	7	4	5
130	83.4	11.8	4.8	248	397	P	99	2	9	11	4	23	..	4	56	7
135	98.3	0.2	1.5	9	7	E	1	..	5	..	..	1	..	..	..	..
159	98.7	0.4	0.9	21	4	G	8	..	9	..	..	..	..	..	1	..
188	99.0	0.2	0.8	1	10	E	1	..	..	..	..	..	..	..	..	..
195	99.0	0.3	0.7	4	9	E	3	..	..	..	..	..	..	..	..	..
199	99.3	..	0.7	2	..	E	..	..	..	..	..	..	..	..	..	..
202	94.8	3.3	1.9	86	169	P	21	7	22	7	5	..	5	..	5	3
208	99.5	..	0.5	1	1	E	..	..	..	..	..	..	..	..	..	..
212	99.5	..	0.5	1	..	E	1	..	..	..	..	..	..	..	..	..
213	99.5	0.1	0.4	2	1	E	1	..	..	..	..	..	..	..	..	1
214	97.8	1.4	0.8	52	38	G	12	9	13	5	1	1	..	2	2	..
ALSIKE.																
1	93.0	4.0	3.0	2	521	G	..	..	..	2	..	..	..	..	..	..
12	89.7	8.5	1.8	149	813	P	..	..	..	103	..	..	..	..	..	..
14	96.2	1.9	1.9	32	157	F	..	..	..	23	9	..	..	..	..	..
19	98.9	0.6	0.5	7	42	G	..	..	..	..	..	..	..	..	..	..
38	6.36	19.0	17.4	140	1728	P	2	..	..	70	16	13	..	..	2	..
45	97.1	1.0	2.5	..	4	E	..	..	..	..	..	..	..	..	..	..
49	91.0	6.4	2.6	40	565	F	..	..	..	18	9	..	..	..	..	13
53	71.2	22.9	5.9	116	2100	P	..	..	2	91	..	..	..	4	..	..
94	85.5	13.5	1.0	75	1498	P	..	4	2	41	2	..	..	..	..	..
99	85.7	12.6	1.7	199	1047	P	..	4	4	52	9	4	..	..	4	..
101	99.3	0.2	0.5	4	10	E	..	..	..	..	..	2	..	..	..	..
128	78.2	18.5	2.3	127	2700	P	2	..	9	27	..	2	..	2	..	..
140	93.4	4.1	2.5	105	327	P	..	4	..	83	..	..	..	..	..	..
187	95.6	2.1	2.3	69	147	F	..	..	..	65	..	2	..	..	..	..
194	93.7	4.6	1.7	40	496	F	..	..	..	9	..	27	..	..	..	..
200	99.0	0.6	0.4	2	61	E	..	..	..	..	..	..	..	..	..	..
201	98.4	1.2	0.4	9	83	G	..	..	..	..	..	..	..	..	..	..
217	97.8	1.5	0.7	2	159	G	..	..	2	..	..	..	..	..	..	..

Grade marks—E excellent, G good, F fair, P poor.

NOTE. The numbers of seeds as shown in the table are expressed as hundreds, omitting the tens and units; thus, for example, the number 16 under the caption red stemmed plantain means that there were present in a pound of the seed under examination sixteen hundred (1600) seed of this particular weed.

TESTS OF RED CLOVER SEED

NOXIOUS SEED (Hundreds)

HARMLESS SEED
(Hundreds)

Lady's thumb	Dog fennel	Plantains	Crabgrass	Kale	Yellow trefoll	Spiny sida	Docks	Panicums	Peppergrass	Ragweed	Five finger	Spurge	Red root plantain	Healall	Miscellaneous seeds (see footnote)	Alsike clover	White clover	Timothy	Miscellaneous seeds
..	..	..	5	..	..	2	1	..	..	..	..	1	2	..	4h,1i	..	..	..	..
..	..	5	..	1	..	..	..	..	..	..	..	..	..	..	(VI)	..	..	5	..
15	9	12	14	7	1	2	3	..	1	1	1	..	1	..	1W,1j,1k	39	89	113	..
14	9	6	8	4	2	2	4	4	4	2	..	..	2	1	(VII)	83	184	292	..
9	..	..	..	..	..	9	..	2	..	..	..	..	..	..	(VIII)	67	160	289	..
..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	9H,4i	88	16	286	7†
..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	1c	4	1	2	..
..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	1	..	9	..
..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	2	..	7	..
3	..	1	..	..	..	1	..	..	..	..	..	..	2	3	1V	19	40	110	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1V	1	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
..	..	..	..	..	..	..	1	..	1	..	..	1	..	..	3s,1V	5	20	13	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Red	4	27	472	18†
..	4	7	..	..	..	16	4	..	..	4	..	..	..	..	9G,2t	23	..	790	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	..	148	..
..	2	..	..	..	16	..	4	..	13	..	..	..	..	..	1f	..	13	29	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2F	159	241	131	18†
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..
..	13	..	..	..	2	..	..	..	..	..	2	..	..	..	2F	55	788	1257	11†
..	..	4	..	..	7	..	..	2	..	7	..	..	..	..	2r,2s,2u	11	423	1060	4†
..	..	32	..	..	43	..	..	18	..	..	..	..	..	..	27G,4r	59	329	650	9†
..	2	11	..	..	..	2	..	..	..	..	..	..	..	..	..	2	4	4	..
..	..	..	..	..	..	..	2	7	..	27	..	7	..	..	20v,7r,2w	16	263	2358	63†
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	16x,2y	34	61	158	72§
..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	102	34	..
..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	83	402	..
..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	41	20	..
..	..	..	..	..	7	..	2	..	..	..	..	..	..	..	..	13	38	32	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	133	20	2†

*German millet. †Red top. ‡Alfalfa. §Meadow fescue. ¶Canada blue grass.

A, Sweet clover; B, Goat's rue; C, Bracted plantain; D, Bitter sweet; E, Low amaranth; F, Canada thistle; G, Chickweed; H, Black mustard; I, Arrowhead tear-thumb; J, Catnip; K, Vervain; L, Smartweed; M, Wild buckwheat; N, Dotted smartweed; O, Spring amaranth; P, Quack grass; Q, Centaurea sp.; R, Three-seeded mercury; S, Nettle; T, Suckling clover; U, Chicory; V, Wild carrot; W, German knot-grass; X, Scentless camomile; Y, False flax; Z, Prairie ribroot.

a, Slender paspalum; b, Pennyroyal; c, Barn-yard grass; d, Mint; e, Nightshade; f, Bitter dock; g, Bladder ketmia; h, Bur clover; i, Polygonum sp.; j, Shepard's purse; k, Ox-eye daisy; l, Sprouting crab grass; m, ground cherry; n, Field bond weed; o, Bull thistle; p, Pennycress; q, Coral berry; r, sedge; s, Hedge mustard; t, Balm; u, Bromegrass; v, Purslane; w, Evening primrose; x, Yellow rocket; y, White top.

TESTS OF MISCELLANEOUS SEEDS

Sample number	Pure seed, percent	Foreign seed, percent	Inert matter, percent	Noxious seed, per lb., hundreds	Harmless seed, per lb., hundreds	Grade	Noxious seed of sundry sorts, hundreds (see footnote)	Harmless seed of sundry sorts, hundreds
RED TOP								
3	90.6	0.4	9.0	5	59	E	5A	59o
31	95.0	0.4	4.6	57	50	E	32B,5C,5D,5E,5F,5G	50o
41	88.2	2.9	8.9	885	540	P	758H,100B,27I	540o
145	92.0	2.4	5.6	23	298	G	18K,5L	270o,23p,5q
206	77.4	10.6	12.0	388	2235	P	234H,63K,50F,13M,9C,5G,9B,5N	2230o,5p
ALFALFA								
80	99.1	...	0.9	2	..	E	2L	
115	97.3	0.1	2.6	3	..	E	10,1P,1Q	
218	95.6	0.4	4.0	10	3	E	4R,2S,2T,1M,1V	3r
OATS								
103	94.0	4.3	1.7	1—	6+	E	V and W	4t,2u
146	96.7	1.5	1.8	1—	1—	E	X and R	t,w&x
BARLEY								
143	96.5	2.5	1.0	1—	5	E	W, Y and V	3z,1x,1t
144	95.0	4.7	0.3	..	11	E		10z,1t
JAPANESE MILLET								
87	90.1	9.4	0.5	127	..	G	59R,37Y,21Z,10a	
142	91.8	5.4	2.8	123	2	G	53R,20b,19c,15d,9Y,3e,2f,1T,1g	2y
KENTUCKY BLUE GRASS								
204	93.4	0.4	6.2	45	..	E	36K,9h	
ORCHARD GRASS								
205	89.4	2.5	8.1	148	67	G	119i,14X,11k,4M	67w,2q
HUNGARIAN								
141	95.5	2.8	1.7	104	1	G	50T,14l,12R,10m,6c,5O,3n,3f,1Y	1s

Grade marks—E excellent, G good, F fair, P poor.

NOTE. The numbers of seeds as shown in the table are expressed as hundreds, omitting its tens and units; thus, for example, the number 16 under the caption red stemmed plantain means that there were present in a pound of the seed under examination sixteen hundred (1600) seed of this particular weed.

A, Sage brush; B, Yarrow; C, Yellow daisy; D, Goldenrod; E, Sheep sorrel; F, Red stem plantain; G, Peppergrass; H, Five finger; I, Common plantain; K, Sedge; L, Dog fennel; M, Ribgrass; N, Mint; O, Lamb's quarters; P, Curled dock; Q, Slender melilot; R, Yellow foxtail; S, Chicory; T, Green foxtail; U, Dock sp.; V, Kale; W, Wild buckwheat; X, Chess; Y, Ragweed; Z, Polygonum sp.

a, Smartweed; b, Spiny sida; c, Barnyard grass; d, Crabgrass; e, Large smartweed; f, Slender crabgrass; g, Spurge; h, Mouse-ear chickweed; i, Velvet grass; k, Ox-eye daisy; l, Lady's thumb; m, Old witch grass; n, Red root pigweed; o, Timothy; p, White clover; q, Red clover; r, Crimson clover; s, Alsike clover; t, Wheat; u, Barley; v, Flax; w, Bluegrasses;

tified in the 53 samples, while the unidentified seeds—perhaps half a dozen in number—were negligible in point of quantity. But one sample in 53 contained the seeds of weeds not already well established and widely known throughout the state. This one contained the seeds of spring amaranth, slender crab grass and field dodder in small quantities. The weeds occurring most commonly and in the greatest numbers were:

Common or native plantain.....	17
Red stem or Rugel's plantain.....	38
Five finger or cinquefoil.....	23
Yellow daisy or black-eyed Susan.....	16
Sheep or field sorrel	11
Lamb's quarters or pigweed.....	19
Sedge or swale grass	11
Peppergrass	16
Evening primrose	16

The following tabular statement shows the weed seeds most abundantly found in timothy samples. It will be noted that numbers 6 and 191, characterized at the opening of this section are the ones in which the most common and pernicious weeds were most largely found.

WEED SEEDS IN TIMOTHY SEED

Name of weed	Number of samples in which it occurred.	Percent of samples in which it occurred.	Maximum number per pound in any sample.	Samples in which it occurred in largest numbers.
Red stem plantain.....	20	38	10,500	No. 191
Five finger	12	23	4,500	No. 191
Common plantain	8	15	1,800	No. 191
Yellow daisy	8	15	2,200	No. 6
Lamb's quarters	10	19	900	No. 137
Peppergrass	7	13	900	No. 100
Evening primrose	7	13	700	No. 138
Sheep sorrel	6	11	1,400	No. 191
Sedge	6	11	700	No. 35

2. *Red clover (43 samples).*—These varied widely in quality and showed a much lower average therein than did the timothy seed. This statement holds both as regards purity percentages and as regards their weed seed contents. Thirty-nine samples of red and four of mammoth clovers were examined, more than three-fourths of them during 1907 and 1908. Apparently the general quality improved markedly in 1909, for the average data for purity in round figures are: 1907, 17 samples 88 percent; 1908, 16 samples 91 percent; 1909, 10 samples 98 percent. The seed of the 1907 market was exceptionally poor; that of 1909 relatively good. The poorer grades of the two former years were probably due more particularly to unfavorable weather conditions and consequent poor seed crops, and to the passage of the Canadian law and the consequent exportation of seed rejected in the home markets. Yet pure seed was obtainable in the two former years, inasmuch as one-third of the samples carried less than one percent impurity. In 1908, following two successive poor seed crops, the average quality improved somewhat, possibly owing to more careful selection. In 1909, following a favorable crop season, the quality was excellent and prices normal. Viewing the situation as a whole, just 20 percent of the samples were 99 percent pure or better; the fourth ranged from 95 to 99 percent pure; one-seventh from 90 to 95; one-seventh from 80 to 90; while one-sixth of the entire lot were of lower grade, three samples showing less than 70 percent purity.

The weed seed content of red clover seed, both as regards the gross amounts present and the species determined, was highly variable, one year as compared with another, one sample as compared with another. Several lots carried each almost the entire gamut of the weed seed contents of the entire 53 timothy samples. Twenty-six known kinds were discovered in the 53 timothy samples, whereas no less than 67 kinds of weed seed occurred in the 43 red clover samples, not to speak of several which were unknown, or reported simply by group name without attempt at discrimination. Eighteen of the 43 carried in excess of a dozen

known varieties of weed seeds, while one showed a third of a hundred sorts and was a veritable posy garden of weeds in embryo. The following weed seeds were found most frequently and in the largest numbers :

- Green foxtail or barn grass,
- Yellow foxtail or pigeon grass,
- The native, the red stemmed, and the English plantains.
- Sheep sorrel,
- White and curled docks,
- Dog fennel or mayweed,
- Lady's thumb or heartease,
- Kale or charlock,
- Lamb's quarters or pigweed,
- Night flowering catchfly or sticky cockle,
- Yellow trefoil or black medic,
- Spiny sida,
- The slender and the sprouting crab grasses,
- Old witch grass,
- German knot grass,
- Black mustard.

The following tabular statement indicates the principal occurrence of weed seeds in red clover seed :

WEED SEEDS IN RED CLOVER SEED

Name of weed.	Number of samples in which it occurred.	Percentage of samples in which it occurred.	Maximum number per pound found in sample.	Serial number of the samples in which it occurred in largest numbers
Green foxtail	33	76	21,500	39
Ribgrass	26	60	3,600	34 & 76
Redstem plantain	25	58	3,900	40
Sheep sorrel	21	48	7,400	39
Night flowering catchfly.....	18	41	6,600	42
Lamb's quarters.....	18	41	6,400	39
Old witchgrass	16	37	2,000	95
Slender crabgrass	16	37	2,000	34
Curled dock	16	37	5,600	130
Yellow foxtail	15	34	700	126 & 130
Lady's thumb	15	34	2,000	40
Dog fennel	12	27	1,800	43
Common plantain	11	25	1,200	126
Crab grass	10	23	1,400	126
Kale	9	20	1,000	39
Yellow trefoil	8	18	2,500	42
Spiny sida	6	14	1,000	90
White dock	6	14	1,700	43
Sweet clover	3	7	5,800	11
Sprouting crabgrass	2	4	900	127
Black mustard	1	2	900	130

Only three weeds were found—the slender and the sprouting crab grasses and the spiny sida—which are relatively rare in Vermont. These three doubtless have been introduced frequently enough to have become established if Vermont conditions had favored their development. The residue constitute the well known widely distributed, and often formidable pests of Vermont farms. The last column in the table above emphasizes the general weedy character of certain samples.

3. *Alsike clover*. As with the red, so with the alsike clover; wide variations in purity and in quality from year to year and as between samples. None of the 18 lots were as pure as were many of the red clovers; likewise none were as poor as were certain red clover samples; nor were there as many kinds of weed seeds found. The same general betterment obtained in the aver-

age quality in 1909 as compared with that of the two previous years and doubtless for the same reasons; 1907, 88 percent; 1908, 85 percent; 1909, 96 percent. The small number of samples analyzed makes yearly tabulation futile. The weed seeds most commonly found and in largest numbers were:

Sheep sorrel,
Yellow trefoil,
Lamb's quarters or pigweed,
Common and red stemmed plantains,
Five finger,
Night flowering catchfly,
Chickweed,
Docks,
Peppergrass,
Sedge,
Purslane,
Yellow rocket.

This list includes several occurring in but one or two samples, but which deserve special mention because of the large numbers present. Twenty-six different weeds were found in the 18 samples, exclusive of those like docks, panicums and chickweeds which could not be discriminated. The chickweeds represent at least three species (*Alsine media*, *A. graminia*, *Cerastum vulgare*) all of which, particularly the latter, occur frequently in al-sike seed. The following table shows the distribution of seeds:

WEED SEEDS IN ALSIKE CLOVER

Name of weed	Number of samples in which it was found	Percentage of samples in which it was found	Maximum number per pound in sample.	Serial number of the samples in which it occurred in largest numbers
Sheep sorrel	12	67%	10,300	12
Yellow trefoil	7	38	4,300	99
Dog fennel	6	33	1,300	53
Docks	6	33	1,600	12
Night flowering catchfly	5	27	2,700	38
Lamb's quarters.....	5	27	900	194
Red stem plantain.....	5	27	3,200	128
Common plantain	4	22	2,700	99
Five finger	4	22	1,800	128
P pergrass	4	22	700	99
Sedge	3	17	2,700	128
Chickweeds	2	11	700	99
Red-root pigweed	2	11	2,000	128
Purslane.....	1	5	1,600	128
Yellow rocket	1	5	.....	140

The seeds appearing in this list are more or less common and most of them are among the most pernicious and persistent varieties. No one of the 26 kinds found could be properly termed a rare weed in Vermont. Although an important means of distributing such weeds as were already common, alsike seed does not seem as likely to do harm by the introduction of new species as is red clover.

4. *Miscellaneous seed.*

(a). *Red top.* Three of the 1907 samples were of average purity, 91.3 percent; two were of very good quality, the inert matter being harmless, the numbers of weed seeds small and the quality of the pure seed good. The other was of much lower grade both as regards purity and weed seed content.

Two 1909 samples showed purity percentages respectively of 92 and 77.4 percent. The pure seed was of rather poor quality and much ergotized seed was observed. Number 206 carried nearly 75,000 ergotized seed per pound, enough at three pounds per acre in seeding mixtures to place upon each square foot nearly five of the sclerotia, each capable under favorable conditions of

producing thousands of spores for the infection of the crop in which they develop.

The only weed seeds not met in timothy or clover were sage brush, golden rod, and yarrow or millfoil. Yarrow, a characteristic impurity of red top seed, was freely distributed through three of the five samples. Five finger was found in two samples in large amounts, 75,000 and 25,000 per pound respectively.

(b). *Alfalfa*. Three samples were of fair to good quality. The nature of their seed contents was practically identical with that met with in red clover seed, the only new seed found being slender melilot, a species of sweet clover. The average purity was 97.3 percent.

(c). *Oats and barley*. Two samples of oats were of excellent quality and high purity. They showed but a trifling weed seed content; though of course, on account of the heavier weight of cereals than of grasses and clovers, the same number of weed seeds per pound represents a much larger number sown per acre. Only four kinds were found: kale, yellow foxtail, wild buckwheat, and chess or cheat, all more or less common weeds.

Two samples of barley were of good quality and fairly high purity, no weed seeds not hitherto mentioned being found in either sample. One showed none whatever. It would seem as if it were not impracticable to free oats and barley from such small and easily screened seeds as kale, which doubtless occur in nearly all the small grains sold in Vermont.

(d). *Japanese millet*. Two samples showed good quality of pure seed, but high weed seed contents (12,700 and 12,300 per pound). Such species as were discovered were already well established on Vermont soil, the only sort not hitherto mentioned in this bulletin being the large smartweed or Pennsylvania persicaria.

(e). *Kentucky blue grass*. But little of this seed is sold in Vermont, the reason being that it is used only for pasture and for lawns. For such purposes, however, it surpasses all other grasses. It could be used here to great advantage, particularly in seeding down pastures. As has been previously mentioned this seed is often adulterated with a Canadian species. The certain detection of its sophistication necessitates expert observation.

The only sample examined here during the three year period was not adulterated. It was secured from a reliable local seedsman, and was represented to be the best grade obtainable from a reputable wholesale house. It showed a weed seed content of two kinds, sedge and mouse ear chickweed. Poorer and adulterated grades may well have been sold and no one been the wiser.

(f). *Orchard grass*. One sample, representing probably the best grade sold in the state, showed a considerable quantity (14,800) of weed seeds of four kinds, velvet grass, chess or cheat, rib grass and ox-eye daisy. Velvet grass seems to be a characteristic but not a serious impurity of orchard grass seed. It occurred in this sample so freely as almost to constitute an adulteration, were it the fact, which is not the case, that velvet grass is apt to be thus used. The more common adulterant of orchard grass is either English or Italian rye grass, neither of which were found.

(g). *Hungarian*. A single sample was of fair quality but showed over 10,000 weed seeds per pound of eight varieties of common weeds, besides some few seeds of slender crab grass. Except for the presence of the smut fungus on some of the seeds the pure seed was of good quality.

WHENCE COME THE WEED SEEDS?

The following table discusses in condensed and tangible form the situation as to the sources of some of the weeds which infest Vermont fields. It epitomizes the several tables shown on pages 218 to 226. It is interesting to note the almost unbroken line of figures in the red clover column. But 18 of the 88 varieties of weed seeds found in this study were not discovered in red clover seed; and one of the 18 (dodder) is not uncommonly discovered therein. Forty-two species were found only in red clover seed; five only in alsike clover; one only in alfalfa; three only in red top; one only in timothy. The total number of species of weed seeds reported is 88. Doubtless many varieties of weed seeds, not discovered in this comparatively small number of desultory examinations, have been sown during these three years upon Vermont farms.

SHOWING PERCENTAGE OF SAMPLES CONTAINING WEED SEEDS OF
DIFFERENT SPECIES

COMMON NAME	BOTANICAL NAME	Timothy, %	Red clover, %	Alsike clover, %	Miscellaneous, %
Green foxtail or barn grass..	(<i>Setaria viridis</i>)	4	84	11	18
Rib grass.....	(<i>Plantago lanceolata</i>)	4	60	16	18
Red-stem plantain	(<i>Plantago rugelii</i>)	38	58	29	12
Sheep or field sorrel	(<i>Rumex acetocella</i>)	11	49	67	6
Night flowering catchfly or sticky cockle	(<i>Silene noctiflora</i>)	..	40	29	..
Lambs' quarters or pigweed..	(<i>Chenopodium album</i>)	19	49	29	12
Old witch grass	(<i>Panicum capillare</i>)	..	40	6	6
Slender crab grass	(<i>Syntherisma filiforme</i>)	2	45	11	12
Curled dock	(<i>Rumex crispus</i>)	2	47	11	6
Yellow foxtail or pigeon grass.	(<i>Setaria glauca</i>)	..	35	6	30
Lady's thumb or heartsease..	(<i>Polygonum persicaria</i>)	4	33	..	6
Dog fennel or May weed....	(<i>Anthemis cotula</i>)	4	28	33	12
Common plantain	(<i>Plantago major</i>)	17	23	22	6
Crab grass	(<i>Syntherisma sanguinalis</i>)	2	21	..	6
Kale or charlock.....	(<i>Brassica arvensis</i>)	..	21	..	12
Yellow trefoil or black medic.	(<i>Medicago lupulina</i>)	..	16	33	..
Spiny sida.....	(<i>Sida spinosa</i>)	..	14	..	6
Docks sp.	(<i>Rumex sp.</i>)	2	30	22	6
Panicum sp. ....		..	11	11	..
Peppergrass	(<i>Lepidium virginicum</i> , <i>L. apetalum</i>)	16	23	29	12
Ragweed	(<i>Ambrosia artemisiae-</i> <i>folia</i>)	..	16	..	23
Five finger or cinquefoil....	(<i>Potentilla monspeliensis</i>)	23	5	22	12
Spurge	(<i>Euphorbia nutans</i>)	..	19	..	6
Common pigweed.....	(<i>Amaranthus retroflexus</i>)	..	14	6	6
Healall	(<i>Prunella vulgaris</i>)	4	11	..	..
Yellow daisy or black-eyed Susan	(<i>Rudbeckia hirta</i>)	16	..	..	12
Sedge or swale grass.....	(<i>Carex sp.</i>)	11	5	17	18
Evening primrose	(<i>Onagra biennis</i>)	16	..	6	..
Chickweed	(<i>Alsine media</i>)	4	5	11	..
Spring amaranth	(<i>Amaranthus spinosus</i>)	2	5	..	..
Menzie's peppergrass	(<i>Lepidium menziesii</i>)	4	..	..	..
Canada thistle	(<i>Carduus arvensis</i>)	2	7	11	..
Blue vervain	(<i>Verbena hastata</i>)	6	5	..	..
Field dodder	(<i>Cuscuta arvensis</i>)	2	..	..	..
Hedge mustard	(<i>Sisymbrium officinale</i>)	2	2	2	..
Mullein	(<i>Verbascum sp.</i>)	2	..	..	..
Sweet clover	(<i>Melilotus alba</i>)	..	7	..	..
Goat's rue	(<i>Tephrosia virginiana</i>)	..	5	..	..
Bracted plantain	(<i>Plantago aristata</i>)	..	7	..	..
Bittersweet	(<i>Solanum dulcamera</i>)	..	5	..	..
Low amaranth	(<i>Amaranthus blitoides</i>)	..	10	..	..
Black mustard	(<i>Brassica nigra</i>)	..	2	..	..

COMMON NAME	BOTANICAL NAME	Timothy, %	Red clover, %	Alsike clover, %	Miscellaneous, %
Arrowhead tear thumb.....	(<i>Polygonum sagittatum</i>)	..	2	..	..
Catnip	(<i>Nepeta cataria</i>)	..	10	..	..
Smartweed	(<i>Polygonum hydropiper</i>)	..	5	..	6
Wild buckwheat	(<i>Polygonum convulvulus</i>)	..	2	..	12
Dotted smartweed	(<i>Polygonum punctatum</i>)	..	7	..	..
Quack grass or witch grass..	(<i>Agropyron repens</i>)	..	2	..	..
Centaurea sp. ....		..	2	..	..
Three-seeded mercury	(<i>Acalypha virginica</i>)	..	5	..	..
Nettle	(<i>Urtica sp.</i>)	..	2	..	..
Sucking clover	(<i>Melilotus officinalis</i>)	..	2	..	..
Chicory	(<i>Cichorium intybus</i>)	..	2	..	6
Wild carrot	(<i>Daucus carota</i>)	..	10	..	..
German knotgrass	(<i>Schleranthus annuus</i>)	..	19	..	..
Scentless camomile	(<i>Matricaria inodora</i>)	..	2	..	..
False flax	(<i>Camelina sativa</i>)	..	2	..	..
Prairie ribroot	(<i>Plantago purslii</i>)	..	7	..	..
Slender papsalum.....	(<i>Papsalum setaceum</i>)	..	7	..	..
Pennyroyal	(<i>Hedeoma pulegioides</i>)	..	2	..	..
Barnyard grass	(<i>Echinochloa crus-galli</i>)	..	10	..	12
Mint.....	(<i>Mentha sp.</i>)	..	2	..	6
Nightshade	(<i>Solanum nigrum</i>)	..	5	..	..
Bitterdock	(<i>Rumex obtusifolius</i>)	..	2	6	..
Bladder ketmia	(<i>Hibiscus triomum</i>)	..	2	..	..
Bur clover	(<i>Medicago denticulata</i>)	..	5	..	..
Polygonum sp. ....		..	5	..	12
Shepard's purse	(<i>Bursa bursa-pastoris</i>)	..	2	..	..
Oxeye daisy	(<i>Chrysanthemum leucanthemum</i>)	..	2	..	6
Sprouting crabgrass	(<i>Panicum proliferum</i>)	..	5	..	..
Ground cherry	(<i>Physalis sp.</i>)	..	2	..	..
Field bindweed	(<i>Convulvulus arvensis</i>)	..	5	..	..
Bull thistle	(<i>Carduus lanceolatus</i>)	..	2	..	..
Pennycress	(<i>Thlaspi arvense</i>)	..	2	..	..
Coral berry	(<i>Symploricarpes orbiculatus</i>)	..	2	..	..
Balm	(<i>Melissa officinalis</i>)	..	..	6	..
Brome grass	(<i>Bromus sp.</i>)	..	..	6	..
Purslain	(<i>Portulaca oleracea</i>)	..	..	6	..
Yellow rocket	(<i>Barbarea vulgaris</i>)	..	..	6	..
White top	(<i>Danthonia spicata</i>)	..	..	6	..
Sage brush	(<i>Artemisia biennis</i>)	..	..	..	6
Yarrow	(<i>Achilles millefolium</i>)	..	..	..	18
Goldenrod	(<i>Solidago sp.</i>)	..	..	..	6
Slender melilot.....	(<i>Melilotus spicatis</i>)	..	..	..	6
Chess or cheat	(<i>Bromus secalinus</i>)	..	..	..	12
Large smartweed	(<i>Polygonum pennsylvanicum</i>)	..	..	..	6
Mouse-ear chickweed	(<i>Cerastrium vulgatum</i>)	..	..	..	6
Velvet grass	(<i>Holcus lannanus</i>)	..	..	..	6

VERMONT'S WORST WEEDS IN 1909

A circular letter was sent in the winter of 1908 to several farmers in various sections of the state asking for the names of the ten worst weeds in cultivated fields, in meadows and in permanent pastures, these to be arranged in order of the damage done. A relatively small number replied, but they were located in widely different sections. The results were combined and computed. It is interesting to compare the results of this survey with the weed seed content of the commercial seed examined during these three years. The following table indicates the worst weeds in the cultivated areas as thus reported, the statements being expressed in terms of percentages.

1. Quack grass (witch grass)	89	8. Smartweed	17
2. Lamb's quarters (pigweed)	45	9. Green foxtail	16
3. Kale	31	Curled dock	15
4. Rough pigweed	30	Canada thistle	17
5. Hedge mustard	35	10. Yellow foxtail	15
6. Sheep sorrel	32	11. Purslane	14
7. Black bindweed	21	12. Bitter dock	12
Ragweed	21	Barnyard grass	12

Every one of the 16 species designated by farmers as being Vermont's worst weeds in the cultivated areas occurs in the foregoing list of weed seeds found in grass and clover seed. Quack grass or witch grass, which leads the list, occurs less often among the grass and clover seeds than does any other one of the 16, doubtless because it matures seed very poorly and propagates almost entirely by its persistent and aggressive rhizomes or underground stems.

The worst weeds in old or permanent meadows were said to be:

1. Sensitive fern	58	7. Orange hawkweed (paint- brush)	21
Ox-eye daisy	58	8. Common plantain	20
2. Tall buttercup	41	9. Common milkweed	18
3. Quack grass or witch grass	32	10. Curled dock	15
4. Wild carrot	31	11. Canada thistle	14
5. Sheep sorrel	27	12. Wild oat grass	12
6. Goldenrods.	22		

Nine out of the thirteen worst weeds in meadows were represented in the grass and clover seed samples. A list of the worst pasture weeds shows only 2 out of 16 weeds whose seeds have been found in grass and clover seeds examined, these being the Canada and the bull thistles, the former appearing in the worst weed lists of both the tilled areas and the meadows.

It would appear that commercial seed is an important factor as a carrier of weeds to cultivated areas and that its relation to the weed seed content of permanent meadows is at least a measurable factor.

VERMONT'S WORST WEEDS IN 1872, 1891, AND 1898, COMPARED
WITH THOSE OF 1909

A Vermont weed list, doubtless the earliest made, was submitted in 1872 by Dr. Cyrus G. Pringle, now keeper of the university herbarium. This contained 129 species, 70 of which were held to be introduced from the old country. Most of the aggressive and prolific weeds of that day were included. During the last forty years the numbers of weeds and of weed species have doubtless increased, owing to new channels of introduction, with western clover seed not the least important one. Prior to the civil war Vermont farmers raised their own clover seed. This practise had ceased, however, by the middle eighties. In 1886, Vermont grown clover seed was sold at \$15 a bushel in competition with western seed at half that price. Economic considerations have forced a change in practise which has opened the door to the influx of western weeds.

The Station made surveys of the weed situation in Vermont in 1891 and 1898. Forty replies to a circular letter touching this matter were received in 1891 and about 200 in 1898. The following weeds appear in each list of the ten or a dozen worst weeds as reported in 1891, 1898, and 1909: Witch grass, white daisy, kale, orange hawkweed, plantains, wild carrot, docks. The following occur in two of the three lists: Brakes, Canada thistle,

goldenrod, ragweed, sorrel. The entire twelve appear in the Pringle list of 1872.

That these weeds are pestiferous is well understood. Of more importance is the relationship of the new comers. The bulk of the weed seed contents of commercial seeds consists of well established sorts, yet such commercial seed is the natural channel for the introduction of those less well known. Only one weed is entered in the 1891 list of ten worst weeds, and but two in that of 1898 of the dozen worst weeds, which did not appear in the list previously made by Dr. Pringle, or reported in this bulletin. But among the 16 worst tillage weeds reported in 1909 appear no less than nine which are not found in the lists of 1891 and 1898; three of which moreover are not even mentioned in the long list of 28 other weeds reported in 1898 as less troublesome than the initial 12 of ill repute. Three of this year's meadow list also have not been hitherto looked upon as serious. While it is freely admitted that the present list is less representative than are the previous ones, because of the small number of farmers reporting, the proportion of species not hitherto considered to be a menace is significant. In short, it is clear that new weeds are rapidly swelling the already long list of these pests, that they are becoming prominent candidates for mention among the most troublesome invaders of meadows and tillage fields, and that the commercial seeds and feeds are their main methods of inlet.

THE NEWER WEED INVADERS

A few specific cases may be cited.

Rib grass or lance-leaved plantain was mentioned in the 1872 list as "appearing occasionally in dry fields." It was ranked sixth among the troublesome weeds in 1891, and was noted in the very complete survey of 1898 as among the ten worst weeds and as "becoming frequent in the hay fields, being introduced in clover seed." This particular seed occurred in two-thirds of the red and one-sixth of the alsike clover samples in the present survey, and in a few timothy and red top samples.

The 1872 list of 129 weeds did not mention yellow daisy or black-eyed Susan. In 1891, it stood twentieth in a list of 40 weeds reported from many sections of the state. It ranked eighth in 1898, although "doubtless reported more often that it deserved to be, owing to its conspicuousness in hay fields and its evident relationship to the old offender, the white daisy. It is a western plant introduced with western seeds." Its seeds were found in one-sixth of the timothy samples and in one red top sample in the present survey, but in none of the clover samples, although apparently sometimes found therein.

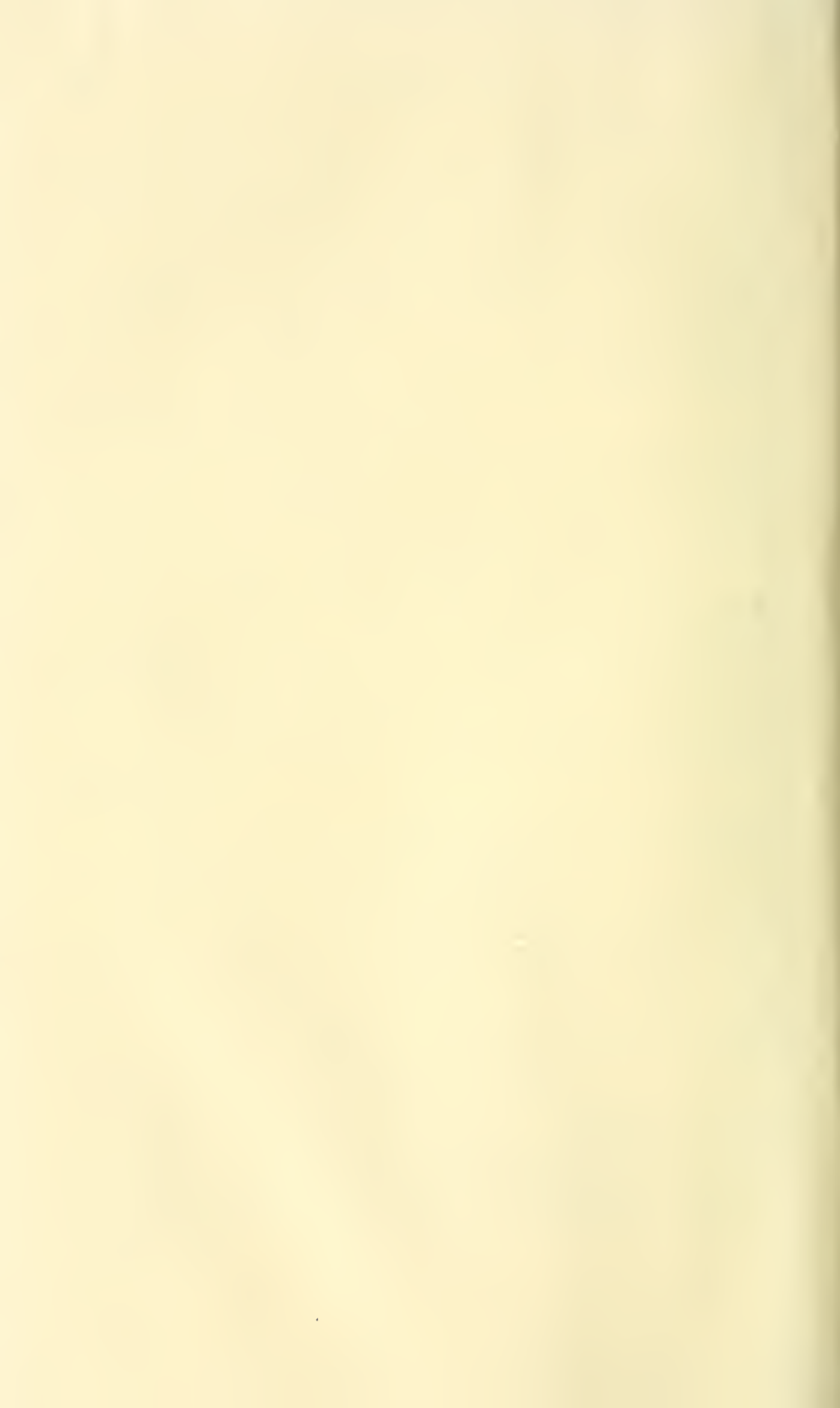
Crab grass was found in one-fourth of the red clover samples and five finger in one-fourth each of the timothy and alsike clover samples and in two out of five red tops. It appears to be introduced in grass seed. Crab grass ranked low among the long lists of 1891 and 1898, and the five finger in that of 1898.

Yellow trefoil is well understood to be an adulterant of red and alsike clover and of alfalfa seed, being imported from Europe principally for this purpose. It was found in one-fifth of the red and in two-fifths of the alsike clover samples. It has not yet been reported as a troublesome weed, being itself not objectionable in meadows and pastures, save that it usurps the place of the better clovers.

Among the weeds not found in this survey, but becoming more common and troublesome, the seeds of which are thus introduced into Vermont, may be mentioned:

Clover dodder (*Cuscuta epithymum*) first reported in Vermont in 1900; blue weed (*Echinum vulgare*); prickly lettuce (*Lactuca scariola*); hoary alyssum (*Berteroa incana*) 1895; tumble mustard (*Sisymbrium altissimum*) 1900; squirrel tail grass (*Hordcum jubatum*); wormseed mustard (*Erysimum cheiranthoides*) and (*Pctstemion laevigatus*).

The first five are most to be feared. Ball mustard (*Neslia paniculata*), particularly abundant and troublesome in the mid-western and Canadian grain fields, has not as yet been introduced but is likely any day to appear in western grain and commercial seed.





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